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In This Issue

The articles in this issue address two widely differing subjects. Smith examines changes in the structure of agriculture. Babula examines international trade in agricultural commodities. Both are significant topics for our time.

In his article on entry into and exit from farming, Smith analyzes the critical elements of change in the structure of agriculture. He focuses on some measurement problems in adapting available Census of Agriculture data to age cohort analysis, but the article is generally concerned with implications for future commercial farm numbers. He concludes that the combined effect of age, debt, and asset positions of current farmers portends a rapid decline in commercial farm numbers.

Through his exercise on world cotton, Babula supports the Armington model as "a promising approach with which to model American agricultural trade issues." Elasticities of world demand for cotton variously estimated with an Armington model are slightly greater than unity. The choice of ordinary-least-squares or seemingly unrelated regression estimators, however, made a substantial difference in the point-estimates of regional elasticities.

The book reviews also reflect a wide range of subjects in agricultural economics and methods of analysis. Fleisher reviews Robison and Barry on firm-level risk and supports their work on the basis that it deals rigorously with a limited portion of the loosely defined area of decision theory. Narrow, rigorous concepts and analysis are not without cost, however, and the authors have sacrificed some scope and applicability.

In his complimentary review of Houck on agricultural trade policy, Wainio reflects on the arguments for free trade policy. Why, in view of the benefits of free trade, are policies that restrict trade so common? Because, as the author points out, the benefits of free trade are widely and thinly distributed and the costs are concentrated on a few.

The performance of irrigation systems in Third World countries is limited by management practices, according to the experts in the book edited by Easter. Day says that Easter's book contains much useful information, but he thinks that most project evaluations could benefit from more attention to macroeconomic policies including exchange rates, exports, and inflation.

The relation of economic models to subject matter is clearly drawn by Mabbs-Zeno in his review of Ravallion's *Markets and Famines*. Although the subject of the book is limited largely to the Indian subcontinent, Mabbs-Zeno finds the analysis of famine useful. Furthermore, the analysis is uncommonly rigorous in the literature of famine.

With this issue we complete the 39th year of the Journal's publication. This year we also commemorate the Constitution and the Ordinance of 1887. These two documents influenced the structure and mechanisms of the economy, but they also established the right to monitor, critique, and describe the economy's performance. As an instrument of the economics profession, the Journal will exercise the rights and responsibilities foreseen in the two documents. We challenge potential contributors to do the same.

Gene Wunderlich

Entry, Exit, and the Age Distribution of Farm Operators, 1974–82

Matthew G. Smith

Abstract. Net entries of young farm operators on commercial-sized farms declined by about 40 percent between 1974 and 1982. Fewer entries of young farmers and the continued aging and retirement of older farmers caused the number of commercial farms to drop between 1978 and 1982. The 1982 age distribution and the 1978–82 entry and exit rates suggest a continuing decline in commercial farm numbers and a redistribution of farm assets. The article uses a modified version of age cohort analysis to estimate rates of net entries and exits of farm operators in 1974–78 and 1978–82.

Keywords. Age cohort analysis, entry, exit, farm numbers.

Long-term changes in the number of farms come about through the entry and exit of farm operators. Entry and exit has three components. The first, which is regular and predictable, is the aging and eventual retirement of current farmers. The second, which is more variable and often the subject of intense public interest and debate, is the early departure of established farmers. The third, often much less noticed, is the rate of entry of new farmers. Together, these components change the total number of farms.

A traditional method of estimating entries and exits in farming has been to use census data on farm operators by age class to derive changes in farm numbers by age cohort.[1] However, the spacing of censuses conducted since 1974, combined with the age intervals used, has made traditional analysis of age cohorts impossible, because data on operator numbers by age are published in 10-year intervals, whereas the last two censuses were conducted 4 years apart.

In this article, I describe a method for approximating net entries and exits of farm operators by age cohort from irregularly spaced census data, and I apply this procedure to estimate entry and exit by age group in commercial farming during 1974–78 and 1978–82. I explore the reduction in entries of young operators after 1978 and the anticipated retirements of older farmers together with generational differences in operator financial structure to examine possible consequences for commerical farm numbers and structure through the nineties.

Research Method

Analysts have used age cohort analysis to examine historical changes in farm numbers and to project changes based on observed relationships between cohort ages and sizes (*2, 5, 6, 7, 10*).[2] The basic procedure is to use published census data on the number of farm operators by age class and compare them with data from other censuses to identify changes over time in the number of operators born within a given decade. For example, one can observe the change between 1959 and 1969 in the number of operators who were aged 25–34 in 1959 by comparing the group's published size in 1959 with its size (now identified as the 35–44 age class) as published in the 1969 census. If censuses are conducted every 5 years, one can compare the size of any 10-year age cohort directly from alternate censuses and easily compute net entries or exits for each cohort.

Age cohort analysis allows one to compare two aspects of changes in farm numbers. First, analysts can compare cohorts reaching the same age in different periods to examine effects of changing economic conditions on groups of operators at the same point in their lives. Second, changes in the total number of farm operators can be attributed to changing rates of

The author is an agricultural economist with the Agriculture and Rural Economy Division, ERS. An earlier version of this article was presented at the 1987 meeting of the Southern Agricultural Economics Association. A number of ERS colleagues provided helpful comments on earlier drafts, especially Calvin Beale, Dave Trechter, Clark Edwards, Tom Stucker, and Fred Hines.

[1] A cohort is defined as any group within a population showing a common characteristic, such as date of first marriage or date of birth. It is used here to denote groups of farmers born in the same decade.

[2] Italicized numbers in parentheses refer to items in the References at the end of this article.

entry or exit by age class or to constant rates operating on a prior uneven age distribution.

Since 1974, the *Census of Agriculture* has been conducted at 4-year intervals (in 1978 and 1982) rather than at 5-year intervals as in the past. The next census will collect data for 1987, resuming the traditional 5-year spacing. Therefore, it will not be until 1992 that two censuses spaced 10 years apart will again be available, but data from the censuses of 1974 and 1978 will still be unusable in traditional age cohort analysis. Yet, this period was one of significant changes in agriculture, and some method of age cohort analysis might help us better understand these changes and their implications.

The method used here to derive net entry and exit rates by cohort for 1974–78 and 1978–82 is to interpolate published data to approximate the single-year age distribution of farm operators, to "age" this distribution by 4 years, and to recombine it into new, synthetic cohort-size estimates. I then compare the size of the synthetic cohort with its observed size 4 years earlier, as published in the previous census. Thus, the 1978 census distribution is interpolated and recombined into synthetic cohorts for comparison with the 1974 census to derive 1974–78 entry and exit rates, and the 1982 distribution is used to arrive at estimates of 1978–82 rates. This procedure allows one to compare different cohorts at the same age in the two periods and to identify the components of changes in farm numbers over each interval.

The choice of interpolation method to apply to the published census data is important when one estimates synthetic cohort sizes. A variety of formulas are available. They range all the way from simple rectangular methods (based on the assumption that all single-year values within a group are equal) to osculatory formulas that rearrange the published group totals to give a smoother curve (*9*, pp. 694–702). Of the available methods, osculatory interpolation procedures that maintain group totals as published are the most appropriate. The procedure used is the Karup-King third-difference formula, an osculatory formula that maintains group totals (*9*, p. 875). I applied the Karup-King coefficients to the 10-year age data to obtain estimates of the farm operator population by year. Table 1 provides an example of these procedures.

Table 1 shows how the numbers of commercial farm operators by age class as given by the Bureau of the Census were interpolated and then recombined to estimate numbers within different age breaks. It shows how the technique was used to estimate net entry of operators aged 25–34 in 1974–78 and 1978–82. Beginning with census data on the number of operators aged 25–34 and 35–44 in 1974, 1978, and 1982, I interpolated the data mathematically to derive estimates of the numbers of operators aged 25, 26, 27 ... 44 in each year. A characteristic of this interpolation procedure is that the sum of the estimates by year of age always equals the total by age class as given in the original data. Thus, the sum of the interpolated estimates equals the group total given by the census. (See note 1, table 1, for a more detailed explanation of the interpolation formula.)

To track the net change between 1974 and 1978 in the size of the cohort aged 25–34 in 1974, I summed the interpolated age distribution for 1978 to estimate the number of operators aged 29–38 (the 25–34 year olds of 1974). This ending cohort size in 1978 (table 1, column 2) appears with its beginning size in 1974 (table 1, column 1) to estimate the net change. The same procedure is used to calculate changes between 1978 and 1982.

The analysis focuses on entry to, and exit from, the "commercial" part of U.S. agriculture, in which operators are engaged in an intentional effort to earn all or part of their income from farming. While it is impossible to ascribe particular motives to any group of farmers based solely on their volume of sales, a large number of rural residence, retirement, and hobby farms had to be excluded to sharpen the focus on commercial agriculture. The analysis is confined to operators of farms with sales of at least $20,000. Although any cutoff point would be somewhat arbitrary and would fail to separate commercial from noncommercial operators completely, the $20,000 sales level is the approximate point beyond which average net cash returns have been greater than zero in recent years (*12, 13*).

To control for the effects of inflation on the $20,000 farm size cutoff, the Bureau of the Census adjusted the data for 1974 and 1978 to 1982 price levels. The price inflator used was the index of prices received by farmers, segmented into crop and livestock components, applied to individual census records. All data discussed here are drawn from the inflation-adjusted tabulation.

Results for U.S. Commercial Farms

Table 2 shows the number of commercial farm operators by age class in 1974, 1978, and 1982 along with the reformulated age distributions for 1978 and 1982 and the entry and exit rates derived from these

Table 1—Computation of net entry/exit rates by cohort, commercial farm operators age 25–34

Item	1974	1978		1982		1974-78	1978-82
	Operators	25-34-year cohorts of 1974 (age in 1978)	Operators	25-34-year cohorts of 1978 (age in 1982)	Operators		
	Number of operators						
Interpolated distribution by age, 25-34:[1]							
25	6,362		9,148		9,523		
26	7,173		10,314		10,788		
27	8,026		11,716		12,384		
28	8,827		12,830		13,576		
29	9,598	13,787	13,787	14,547	14,547		
30	10,341	14,586	14,586	15,297	15,297		
31	11,054	15,228	15,228	15,828	15,828		
32	11,738	15,712	15,712	16,137	16,137		
33	12,394	15,970	15,970	16,111	16,111		
34	13,017	16,278	16,278	16,210	16,210		
Sum of interpolation[2]	98,530		135,569		140,400		
Interpolated distribution by age, 35-44:[1]							
35	13,583	16,505	16,505	16,249	16,249		
36	14,193	16,899	16,899	16,505	16,505		
37	14,809	17,436	17,436	16,988	16,988		
38	15,486	17,963	17,963	17,376	17,376		
39	16,212		18,519		17,749		
40	16,986		19,103		18,108		
41	17,807		19,716		18,453		
42	18,677		20,358		18,783		
43	19,512		20,969		19,072		
44	20,642		21,785		19,429		
Sum of interpolation[2]	167,907	160,363	189,252	161,247	178,712		
Cohort size and source:							
Beginning (census)						98,530	135,569
Ending (interpolated sum)[3]						160,363	161,247
Change (net entrants) (= ending minus beginning size)						61,833	25,678
Average entrants/year (= net change / 4)						15,458	6,420

Blanks indicate not applicable.

[1]Ten-year age intervals were interpolated to estimate the age distribution by year with the Karup-King third-degree difference formula. The formula is a set of coefficients that are expressed in the form of differences and applied to grouped data to estimate the distribution within the interval. It does so by fitting a second-degree polynominal function (plus an adjustment using third differences to assure a smooth fit between adjacent intervals) to the grouped data. Unlike some other interpolation formulas, the Karup-King formula maintains the group sums as originally given. For example, the coefficients for the first fifth of a middle interval (not at either end) are 0.064 × the preceding interval plus 0.152 × the interval to be interpolated plus −0.016 × the following interval. The number of operators under 25 in 1978 was 29,422. To estimate the first fifth of the 25-34 age class in 1978 (the number of 25 and 26 year olds), use the formula: (0.064 × 29,422) + (0.152 × 135,569) + (−0.016 × 189,252) = 19,462. A second set of coefficients operates in similar fashion to partition the interpolated fifths into halves to give estimates of operators by each year of age. For a more detailed explanation, see (*9*, pp. 699-700).

[2]The interpolated values sum to the total for the age class as given by the Bureau of the Census.

[3]The estimated ending (interpolated sum) cohort size is referred to as the "number of operators aged up to 28, 29 to 38 . . . 69 plus" in table 2.

distributions.[3] The shift in the age distribution of commercial farm operators between 1974 and 1982 is evident from the census tabulation alone. In 1974 the single largest group of farmers was between 45 and 54; by 1982 the largest group was between 55 and 64. By 1982 the number of operators aged 44 and under was higher than in 1974; the number aged 45 to 64 was lower; and the number aged 65 and older was again larger than 8 years before. The figure compares the interpolated age distributions for 1974 and 1982.

Entry and exit rates by cohort derived from the interpolated distribution show that entries of younger operators decreased between 1974–78 and 1978–82.[4] In 1974–78, the average annual increase of cohorts with beginning ages of up to 34 (in 1974) was nearly 29,000 operators each year. In 1978–82, annual net entrants with beginning ages up to 34 (in 1978) numbered fewer than 18,000, a decline of nearly 40 percent from the earlier period.

In the middle-age groups, with beginning ages from 35 to 54, the pattern of net changes also shifted from 1974 to 1982. The cohort with beginning ages of 35–44 in 1974 grew at a rate of 12,000 farms per year up to 1978; this number dropped to about 1,000 farms per year for the cohort with the same beginning ages in 1978. The next oldest groups, with initial ages of 45–54, shifted from net growth in 1974–78 (1,800 farms per year) to net loss in 1978–82 (6,700 farms per year).

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[3]Note that age cohort analysis only allows us to identify net entries to and exits from a cohort. Some operators probably enter a cohort whose total size is decreasing or leave one while it is growing. Some operators may also enter and exit between one census and the next. Movements of these types cannot be identified. Also, because the analysis focuses on commercial farms with annual sales of $20,000 or more, entry and exit are defined in terms of this threshhold rather rather than as absolute entry or exit. Thus, farms could grow or shrink and yet be identified as entries or exits.

[4]This analysis differs from previous studies in that increases in the size of growing cohorts are measured in terms of the actual number of additional operators, rather than as a percentage increase from its size in an earlier census or, for the youngest group, as a proportion of the oldest cohort in the preceding period. This procedure seems more appropriate for depicting the circumstances of the seventies and eighties. The traditional approach assumed a "normal" pattern of cohort growth based on its size at an early age; yet cohorts have historically exhibited a great deal of variation in their growth patterns (*4*, pp. 366–7). And, with commercial operators relying increasingly on leased cropland and with the rapid obsolescence of specialized livestock facilities, the number of farmsteads given up by retiring operators is less closely linked to entry opportunities now than it was 20–30 years ago.

U.S. Commercial farms by operator age, 1974 and 1982

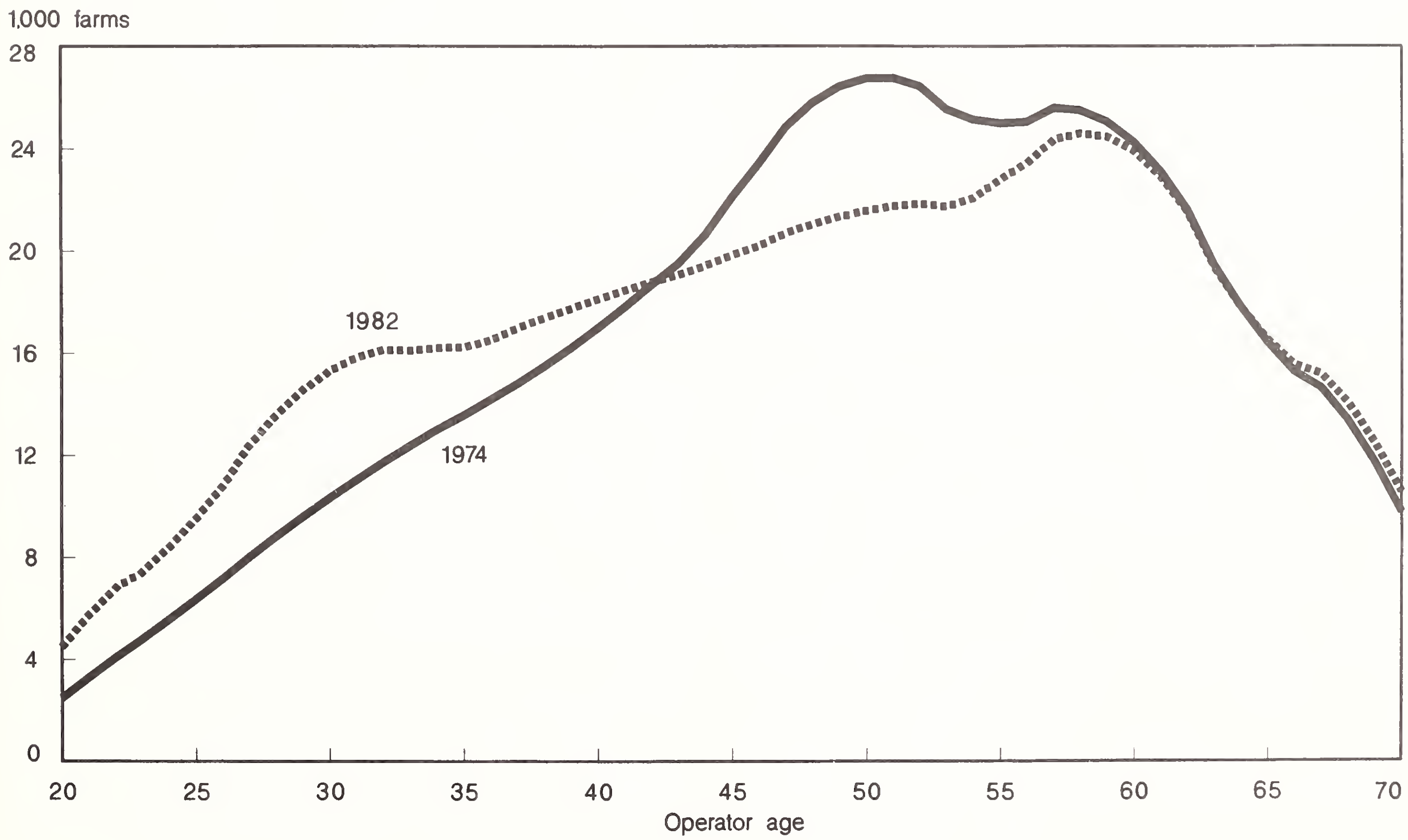

Table 2—Derived net entry and exit of U.S. commercial farm operators, by age, 1974-78 and 1978-82

Item	Age						
	Up to 24	25-34	35-44	45-54	55-64	65 plus	Total
	Number of operators[1]						
Census age distribution:							
1974	19,454	98,530	167,907	253,269	232,421	93,442	865,023
1978	29,422	135,569	189,252	252,442	242,573	92,382	941,640
1982	28,582	140,400	178,712	212,228	225,189	98,845	883,956
	Age						
	Up to 28	29-38	39-48	49-58	59-68	69 plus	Total
	Number of operators[2]						
Interpolated age distribution:							
1978	73,430	160,363	217,350	260,490	199,335	30,671	941,639
1982	74,852	161,247	193,450	225,579	191,368	37,459	883,955
	Age						
	Up to 24	25-34	35-44	45-54	55-64	65 plus	Total
	Number of operators[3]						
Annual change by beginning age:							
1974-78	13,494	15,458	12,361	1,805	–8,272	–15,693	19,154
1978-82	11,358	6,420	1,050	–6,716	–12,801	–13,731	–14,421
	Percent change						
1974-78	69.36	15.69	7.36	0.71	–3.56	–16.79	2.21
1978-82	38.60	4.74	.55	–2.66	–5.28	–14.86	–1.53

[1]Source: Special tabulation, U.S. Department of Commerce, Bureau of the Census. A commercial farm is defined here as one with annual real sales of $20,000 at 1982 prices. Data for 1974 and 1978 are adjusted to 1982 prices from the index of prices received by farmers. Data for 1978 exclude area sample farms.

[2]Source: Interpolated census tabulation summed to estimate farm numbers by revised age class. For example, numbers of operators aged 29-38 in 1978 (160,363) and 1982 (161,247) are those derived in table 1. Sum of interpolated distribution does not sum exactly to published total because of rounding.

[3]Annualized net entry/exit rates calculated as follows: Farms per year = (ending cohort size – beginning cohort size)/4. Percent per year = farms per year as a percentage of beginning cohort size. For example, for the cohort aged up to 24 (for this analysis it is assumed that none was aged less than 15) in 1974, farms per year = (73,430 – 19,454)/4 = 13,494; percent per year = (13,494 / 19,454) * 100 = 69.36 percent.

Among older operators with starting ages of 55 and up, declines were more stable over the two periods. The number of farmers aged 55–64 declined 3.6 percent per year in 1974–78 and declined 5.3 percent per year in 1978–82. However, the average annual decline for the oldest class fell somewhat, from 16.8 percent to 14.9 percent.

These results indicate that the drop in the number of commercial farms in 1978–82, coming on the heels of the 1974–78 increase, can be attributed almost entirely to a decreased net entry of younger operators. These findings are similar to those of Johnston and Tolley (*4*) and Tolley (*10*). Using farm/nonfarm income ratios to estimate the elasticity of changes in cohort size with respect to relative farm and nonfarm income prospects, Johnston and Tolley have shown that cohorts' responsiveness to nonfarm opportunities decreases with age. Thus, most of the response to changing economic conditions comes from younger cohorts—those who under "normal" circumstances would be expected to increase.

Regional Variations

Table 3 shows net entry and exit rates by age group and region. I derived these estimates by applying the procedure just outlined to regional data on commercial farms by operator age in 1974, 1978, and 1982. Results for the 10-year age groups are combined into 20-year intervals in the table for the sake of brevity.

Table 3—Annual net entry and exit by region and age group, 1974-82[1]

Region	Under 35 years			35-54 years			55 and over		
	1974-78	1978-82	Change[2]	1974-78	1978-82	Change[2]	1974-78	1978-82	Change[2]
	Farms per year		*Percent*	*Farms per year*		*Percent*	*Percent per year*		*Percent*
Northeast	1,747	1,275	–27	440	–383	–187	–8.04	–7.20	–10
Appalachia	2,885	1,502	–48	2,695	–486	–118	–4.68	–7.66	64
Southeast	1,626	620	–62	1,290	–515	–140	–7.01	–8.34	19
Lake States	3,981	3,512	–12	857	–344	–140	–8.64	–8.63	0
Corn Belt	8,257	4,628	–44	3,045	–2,171	–171	–7.78	–8.71	12
Delta	1,462	690	–53	817	–536	–166	–8.69	–8.88	2
Southern Plains	2,110	890	–58	2,090	–778	–137	–4.66	–7.87	69
Northern Plains	3,711	2,757	–26	209	–531	–354	–9.03	–7.38	–18
Mountain	1,590	930	–42	1,067	–174	–116	–6.05	–6.82	13
Pacific	1,585	975	–38	1,656	251	–85	–5.59	–5.88	5
United States	28,953	17,777	–39	14,167	–5,666	–140	–7.35	–7.92	8

[1]Age classes are combined from classes presented in table 2. For example, net entry of operators aged under 35 combined the results for the "up to 25" and "25-34" age classes in table 2. Slight differences between the totals reported for the combined age intervals here and the sums of the 10-year classes reported in table 2 are due to rounding.

[2]Percentage change, 1978-82 rate over 1974-78 rate.

Table 4—Implied change in commercial farm numbers at 1978-82 entry/exit rates

Region	Actual rate	Implicit rate[1]			
	1978-82	1982-86	1986-90	1990-94	1994-98
	Percent change				
Northeast	–4.17	–4.61	–4.39	–3.80	–2.90
Appalachia	–6.12	–6.17	–5.62	–4.69	–3.53
Southeast	–11.39	–11.69	–11.00	–9.79	–8.22
Lake States	–.82	–1.20	–.48	.44	1.41
Corn Belt	–8.44	–6.62	–6.86	–5.51	–3.91
Delta	–9.26	–4.02	–5.08	–4.64	–3.59
Southern Plains	–12.03	–12.01	–11.26	–9.86	–8.00
Northern Plains	–3.97	–4.41	–3.92	–2.91	–1.58
Mountain	–5.13	–6.02	–5.83	–5.05	–3.89
Pacific	–.80	–2.07	–2.46	–2.32	–1.73
United States	–6.13	–6.16	–5.48	–4.37	–3.01

[1]Implicit changes in future farm numbers are calculated as follows: The 1978 and 1982 census age distributions (table 2) were interpolated as in table 1 and were then used to calculate net changes in farm numbers for *each year of age* of the 1978 operator population. For operator age groups growing in size, the rate of change is expressed as the number of net entrants in 4 years. For age groups declining in size, the rate of change is expressed as the percentage of operators leaving within 4 years. All operators are assumed to exit by age 75.

These 1978-82 rates of change in operator numbers by age were derived for each region and for the United States and were then applied to the 1982 age distribution to arrive at the implicit distribution for 1986. The 1986 implicit distribution was then summed and compared with the 1982 total to arrive at the implicit change in the total number of commercial farms between 1982 and 1986. The implicit 1986 age distribution was then used to derive the implicit distribution in 1990, again from the 1978-82 entry and exit rates. This iterative process was used to derive the total change in commercial farm numbers to 1998, implicit in the 1978-82 entry/exit pattern and the 1982 age distribution.

A sharp drop is apparent in the number of younger operators entering during 1978–82. Three southern regions—the Southeast, Southern Plains, and Delta—had the most severe declines in net entries, with the number of new operators aged under 39 by 1982 falling by more than half compared with the earlier period. Net entry of younger operators held up best in the Lake States, where the 1978–82 entry rate was 88 percent of the 1974–78 level. This phenomenon may partly reflect the relatively favorable outlook for dairy operations that persisted into the early eighties, even as the outlook for other commodities began to dim. The general reduction in net entries during 1978–82 was also probably tempered somewhat by the decline in rural nonfarm job opportunities that was apparent by 1982.

The two middle cohorts, aged 35–54, show an abrupt change from net entry in 1974–78 to net withdrawal in 1978–82, except in the Pacific region, where net entries dropped to 15 percent of their earlier level.

Among older operators, aged 55 and up, average annual exits as a percentage of initial cohort size show far more stability. Regional exit rates are remarkably consistent, except for the Appalachian and Southern Plains regions, where 1974–78 exit rates were somewhat depressed.

The regional analyses buttress the results at the national level. They indicate a steep drop in the number of younger operators beginning farming after 1978, combined with a quite stable rate of retirement of established older operators. Yet, net entry rates do vary by region.

Implications for Future Farm Numbers

The sharply reduced net numbers of young people entering commercial agriculture in 1978–82, combined with the shift in the overall age distribution of operators, could significantly affect the number of commercial farms in the short run (table 4).

I computed future changes in the number of commercial farm operators implicit in the 1978–82 entry and exit rates by comparing the interpolated 1978 age distribution with the interpolated 1982 distribution, "aged" 4 years, to derive changes in the size of a single year's age group during 1978–82. For example, I compared the number of operators aged 35 in 1982 (estimated by interpolation) with the estimated number of operators aged 31 in 1978 to obtain the 1978–82 growth rate for farmers aged 31 in 1978. I then applied these age-specific rates of growth or shrinkage to the 1982 age distribution to arrive at a projected age distribution for 1986. Using the same procedure on the projected age distribution, I derived subsequent projections of operator numbers by age for years beyond 1986. I computed and applied rates of growth for cohorts increasing in size in terms of the number of net entrants; rates of decline for older cohorts are applied in terms of the percentage of operators in the previous period. It is assumed that all operators exit farming by age 75.

The projected farm numbers for 1986 and beyond thus serve as a baseline from which to observe the effects of the age distribution of current operators on short-term changes in the total number of farms, if the net number of younger entrants remains constant at the 1978–82 level. Given the inelastic rate of change in older cohorts, any additional impacts of current economic conditions on younger age groups, such as an increase in the rate of departure from middle-age groups or further reductions in the entry of younger operators, would be expected to decrease the number of commercial farms even more.

Note that the assumption of a constant level of net entry of young operators actually implies an increase in the entry rate of farm-born youth into commercial farming. The most recent survey data (1973) continue to show that the overwhelming majority of farm operators come from farm backgrounds. This situation would presumably be even more apparent for the commercial operators considered here. However, the size of the pool of farm-born youth is shrinking. The total number of U.S. births peaked about 1960; it may have peaked somewhat earlier among farm families, which were declining in number throughout the period (*1*). Therefore, the largest recent cohort of potential farm entrants is now in its mid- to late twenties, the age at which entry into farming has historically been most common (*5*). For the number of net younger entrants to remain constant at the 1978–82 level, an increasing proportion of entrants would need to be drawn from the smaller cohorts that follow.

The 6-percent reduction in the number of commercial farms in the Nation between 1978 and 1982 would have increased slightly to 1986 as the "bulge" of older operators continues to retire. The somewhat smaller groups following them would decrease the rate of retirement thereafter, reaching a net decline of 3 percent during 1994–98.

One can make a tentative check of the results for 1986 by comparing them with those reported by the National Agricultural Statistics Service (NASS) in its 1986 estimate of U.S. farm numbers (*14*). NASS estimated approximately 823,600 farms with sales of $20,000 and over in 1986, a decline of just under 7 percent from the total reported in the 1982 *Census of*

Agriculture. If the NASS estimates are accurate, they show a decline in commerical farm numbers about 10 percent higher than those suggested by the 1978–82 entry/exit rates and the 1982 age distribution. The data suggest some combination of further reductions in entries of younger operators and increases in early departures of established operators.

There is a great deal of regional variability in the implicit patterns of change (table 4). This variability stems from the combination of the operator age distribution in 1982 and the observed age-specific rates of entry and exit in each region. If the 1978–82 entry and exit rates were maintained, the age distribution would boost the rate of net decrease in total farm numbers in 6 of the 10 farm production regions in 1982–86 (the Northeast, Southeast, Lake States, Northern Plains, Mountain, and Pacific). The 1978–82 rate would hold nearly steady in the Southern Plains and Appalachia; it would fall 57 percent in the Delta and 22 percent in the Corn Belt. Most regions would experience decreasing rates of net decline after 1986; however, the total number of farms in the Lake States would begin to increase again after 1990, if the relatively high entry rate of 1978–82 were to continue. The Delta and Corn Belt are exceptions; their rates of net departures are projected to increase in 1986–90 before declining again. In neither region is any future rate of decline projected to exceed the 1978–82 level, however. The net rate of decline is also projected to increase through 1990 in the Pacific region, and then to ease somewhat.

Operator Entry and Financial Stress

Analysis of the age distribution of commercial farm operators indicates that there was a substantial entry of young people into farming in the seventies, which fell significantly by 1982. In the same period, the peak of the age distribution shifted from about 50 to 58 years. Thus, one legacy of the seventies and early eighties to U.S. farm structure was a commercial operator population that is in a sense both younger and older than it was in 1974 (see figure). This age distribution has potentially important implications for the number of commercial farms, particularly if the rate of entry of younger operators falls further. These developments go well beyond farm numbers, however.

The conditions and expectations that attracted young people to farming in the seventies also drove up the cost of farm assets. Thus, many entrants of the mid- and late seventies took on heavy debt loads to acquire production assets. The result is illustrated by data from the 1985 Farm Costs and Returns Survey (table 5). Although these data are for all operators, farms with sales of $20,000 and up held almost 80 percent of all assets and over 90 percent of all debt; the data thus approximate generational differences in the financial structure of commercial farms.

Table 5—Selected financial characteristics by age class, all operators, January 1986

Age	Assets	Debts	Equity	Interest expense	Debt/asset ratio of 0.4 or less	Debt/asset ratio of 0.4 or less and positive cashflow
	Percent of total				*Percent of class*	
Under 35	10.84	17.81	8.81	15.98	55.13	30.33
35 to 44	21.09	28.58	18.91	27.70	66.99	30.24
45 to 54	24.69	26.57	24.14	27.00	78.53	34.13
55 to 64	25.77	20.77	27.22	22.60	89.39	47.95
65 plus	17.61	6.27	20.92	6.72	96.53	47.15
	Billion dollars					
U.S. total	504	114	390	12.6	78.66	38.55

Source: Derived from (*13*, tables 23 and 28).

As of January 1986, operators under the age of 45 held 32 percent of total assets, but 46 percent of the debt, and only 27 percent of total equity. However, operators aged 55 and over held about 44 percent of total assets, 27 percent of debt, and 48 percent of total equity. Thus, nearly half the production assets of U.S. agriculture are currently held by a group of operators from which a high rate of retirements can be expected over the next decade. Under normal circumstances many of these assets would be acquired by a younger generation of operators through purchase and inheritance. However, this transfer is complicated by the high debt load already carried by farmers who entered agriculture in the seventies.

Although debt/asset ratios in themselves are only crude indicators of ability to carry additional debt, they do indicate the number of highly leveraged producers who are most at risk of having financial difficulty. The proportion of farms with debt/asset ratios of 0.4 or less drops dramatically, from over 97 percent among operators aged 65 and over to 55 percent among operators aged under 35. This relationship is not unexpected, given the paying off of land loans over an operator's lifetime. However, the proportion of operators aged under 45 with low debt/asset ratios and positive cash flows drops to 30 percent when one excludes farms with a negative cash flow after principal and interest payments so as to identify the most likely candidates for absorbing additional debt. Given the recent tendency for most farm assets to be acquired by established farmers rather than by new entrants or investors, it seems that this 30 percent of younger operators is now the group most able to acquire the assets soon to be released by retirement of older operators.

The combined impact of age, debt, and asset distributions in U.S. agriculture could be profound. We have already seen that fewer entries of younger operators, combined with the inescapable retirement of older operators, would hasten the decline in the total number of U.S. farms. If financial difficulties force more early departures of some operators, these departures will most likely come from among younger farmers who entered farming in the seventies. This situation would accelerate the decline in farm numbers.

This situation might also accelerate the redistribution of assets and equity in the farm sector. Nearly half of all assets are nearing release by their current operators; less than one in three younger operators is in a strong position to acquire ownership of these assets. A number of possibilities arise for transfering these assets. First, they might pass into the hands of those among the younger generation of operators who are in good financial condition, thereby concentrating farm assets among far fewer operators. Second, they might be held by retirees and their heirs and be operated under lease arrangements, shifting the capital structure of operators and further fragmenting the ownership of farm resources. Or, third, they might pass into the hands of nonfarm investors, shifting the control of, as well as the returns to, agricultural assets further away from rural communities.

Fewer entries of new young operators and more exits of younger established operators might also have important effects on the aggregate efficiency of the farm sector. If early withdrawals from farming have increased in the eighties, those leaving the sector are far more likely to do so because of financial, rather than technical, inefficiency (essentially, guessing wrong on asset values) (*8*). Increased departures from this group of mainly younger operators may reduce the technical efficiency of the farm sector at a time of increasing international competition. Furthermore, a farm operator population increasingly skewed toward older age groups may not adopt new technologies as quickly as a younger population might.

However, entry into agriculture is cyclical, falling off when entry costs are high and prospective returns low and increasing again as barriers shrink and prospects improve. Recent declines in farm asset values and imminent retirements of established operators may improve opportunities for profitable entry over the next decade. For the number of net commercial entrants to increase from the 1978–82 level, however, some combination of reduced exits of established younger operators, increased rates of entry from the smaller oncoming cohorts of farm-born youth, or more entrants from nonfarm backgrounds would be needed.

The number of future entrants into commercial farming will be affected by a number of factors: international monetary and trade policies, the relative performance of the nonfarm economy in providing attractive alternatives to farming, and technological changes. Domestic agricultural policy will also play an important role. Commodity policies designed to protect the incomes of existing operators may both encourage new entrants by providing a more secure environment for the nascent firm and discourage new entrants by inflating asset prices and raising entry costs. Output-restricting policies will likely pose entry barriers, particularly if pursued through production quotas. Credit programs targeted to assist beginning farmers have been deemphasized recently because of concern over production surpluses. Perhaps it would now be useful to sharpen the distinction between output-increasing investments and those that transfer production assets from one generation to the next.

Conclusions

The peak of the age distribution of commercial farm operators (defined here as those with farms having real sales of $20,000 or more) trended upward between 1974 and 1982, from about 50 to 58 years. A secondary "bulge" of operators about 30 years of age also appeared during the same period. Age cohort analysis indicates that this trend resulted from a relatively high rate of net entry of younger operators in 1974–78, which then dropped significantly in 1978–82. Net departures of older operators continued at a stable rate in both periods.

Assuming that the 1978–82 entry and exit rates by age groups remain unchanged, the rate of decline in the number of U.S. commercial farms would be expected to accelerate slightly in 1982–86 and slow thereafter. Regional rates of change would vary widely because of differences in entry and exit rates and operator age distributions in 1982.

Whether or not the 1978–82 net entry rate of younger operators will be sustained is an open question. A diminishing pool of farm-born youth from which to draw entrants, current widespread financial distress in the farm sector, and uncertainty about the future of agricultural policy may dampen entry further. However, fewer entry barriers in the form of lower land, interest, and used machinery costs may induce entrants from among those put off by the high capital and carrying costs of 1978–82.

Because the retirement of aging operators is inescapable, the number of young people entering farming in the next decade and the kinds of farms they operate will largely determine the structure of U.S. agriculture at the end of the century. In this connection it is important to note that two recent sets of projections of U.S. farm numbers and sizes in the year 2000 reached widely differing results. However, each was derived without any explicit consideration of the age distribution of farm operators and the implied numbers of new entrants required to meet various totals of farm numbers by the turn of the century (*3, 11*). Future attempts at modeling the future of the farm sector could benefit from greater attention to the demographic aspect of farm structure.

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An Armington Model of U.S. Cotton Exports

Ronald A. Babula

Abstract. A multiregional Armington model of U.S. cotton exports is estimated inappropriately with ordinary least squares (OLS) and appropriately with seemingly unrelated regression (SUR). Trade elasticity estimates and out-of-sample forecast performance demonstrate the importance of using the correct econometric technique. The choice of estimator clearly influences the model's forecast accuracy out of sample, levels of trade parameter estimates, and degrees of coefficient estimate efficiency. Four shortcomings of the agricultural trade literature are addressed: (1) frequent neglect of trade theory, (2) excessively wide ranges of trade parameter estimates, (3) frequent misuse of OLS, and (4) failure to validate models out of sample.

Keywords. Armington theory, U.S. cotton trade, ordinary least squares (OLS), seemingly unrelated regression (SUR), forecast performance, price elasticities.

The agricultural trade literature appears deficient on at least four accounts, according to Chambers and Thompson. First, the literature has often ignored international economic theory and its advances (*4*, p. 2). Second, the range of the estimates for U.S. policy-relevant trade parameters such as the price elasticities of foreign demand for U.S. cotton is excessively wide (*24*). The profession, thus, has no consensus on a reasonable confidence interval for the true values of these parameters. Third, researchers have often not validated agricultural trade models beyond the sample (*24*). Fourth, researchers have too often ignored econometric problems and have inappropriately estimated agricultural trade models with ordinary least squares (OLS).

In this article, I address these criticisms in the context of the U.S. cotton trade. First, I apply Armington's theory of international demand for commodities differentiated by kind and origin (hereafter Armington theory) to a multiregion model of U.S. cotton exports. Armington theory is considered a theoretically powerful approach with substantial economic content—a promising approach for modeling issues in U.S. agricultural trade (*22, 24*). Yet the Armington approach is still new to U.S. agricultural trade modeling, particularly cotton (*24*).

Second, I estimate the Armington model with an inappropriate technique, OLS, and with the appropriate econometric estimator, Zellner's seemingly unrelated regression (SUR). A comparative analysis of the model estimated with these two techniques addresses Thompson's complaint that econometric problems are often not confronted.

Third, I calculate U.S. trade-relevant parameters and compare them for the model's OLS and SUR "versions." An estimate range (OLS, SUR) is generated for each coefficient and, hence, trade parameter. The results address Thompson's criticism of the literature's wide range of trade parameter estimates.

Fourth, I test and compare forecast performances of the OLS and SUR versions of the Armington model out of sample. This procedure addresses Thompson's criticism that trade models are often not validated.

Addressing these criticisms with four objectives exposes several interrelationships. Ignoring econometric problems and inappropriately estimating the Armington cotton model with OLS introduces sizable deviations in parameter estimates from SUR-estimated levels. Furthermore, choosing between the appropriate econometric estimator and an inappropriate one noticeably influences the out-of-sample forecasts of the Armington model.

Armington's Theory

Armington provided an important insight in international trade theory. His theory provided a way to account for the fact that commodities in international trade are differentiated by place of origin as well as

The author is an agricultural economist with the Agriculture and Rural Economy Division, ERS. He thanks Gerald Schluter for his help in all phases of this study's development.

[1]Italicized numbers in parentheses refer to items in the References at the end of this article.

by kind. U.S. and Mexican cotton are therefore imperfect, rather than perfect, substitutes.

However, no Armington study of U.S. cotton exports has yet appeared in major books or journals. A concise presentation of the specifications and advantages of Armington theory will follow. Detailed presentations of derivations and specifications appear in two of his earlier articles (*1, 2*). Grennes, Johnson, and Thursby (*10*) and Johnson, Grennes, and Thursby (*15, 16*) present detailed summaries of Armington's theory within the context of U.S. agriculture.

Armington's theory (*2*) differentiates a commodity supply by kind and origin. Following Armington (*2*, pp. 159–60), we see that a "good" or "market" is a commodity differentiated by kind, as cotton is from corn, for example. A "product" is differentiated by both kind and origin. U.S. and Mexican cotton exports represent two imperfectly substituted products within an importing region's cotton market. Importers are often observed as treating a good's supplies from different exporters as imperfect substitutes (*2*, p. 159, *15, 16*). Thus, an importer performs a two-stage optimization. In stage 1, the importer decides the total amount of cotton to import from all sources. The importer then determines the optimal levels of *product* imports.

Armington made three assumptions (*2*, p. 161). First, importer preferences are homogeneously separable. Armington realized two advantages of homogeneous separability. Phlips (*21*, pp. 72–76) demonstrated that weak separability, a condition implied by homogeneously separable preferences, is required to incorporate two-stage optimization. Green (*9*, pp. 150–54) has shown that homogeneous separability, a stronger condition than weak separability, is necessary both to endogenize two-stage optimization and to do so in a way that will generate the same demanded product quantities of the more conventional single-stage process.

Second, Armington (*2*, p. 161) assumed that an importer's substitution elasticities defined over product pairs are constant.

Third, Armington (*2*, p. 161) assumed a common substitution elasticity for each product pair within a particular market (for example, cotton). These assumptions suggest an importer utility function that is homogeneously separable, and has a constant elasticity of substitution (CES) (*2, 15*). An importer groups cotton exports into a cotton market quantity (or utility) index that is linearly homogeneous and that serves as a CES utility function argument (*2*, p. 167). The importer first maximizes real national-income-constrained utility to determine a Marshallian total cotton demand (equation 1). Following Armington (*2*), the importer then minimizes expenditures on all cotton products subject to the first-stage demand or utility level. Armington (*1, 2*) derived equation 2 as the importer's second-stage demand for a product, in this case, U.S. cotton. Relation 3 is equation 2's natural logarithm form that is actually estimated. Region-specific variables were added to equations 1 and 3 because Armington's theory was derived along the general lines of an arbitrarily selected commodity and importer. Armington (*2*) also derived equation 4, the own-price elasticity of an importer's product demand (hereafter direct-price elasticity):

$$x_i = h^i(RLY, p_1,\ldots,p_i,\ldots,p_n) \tag{1}$$

$$x_{ij} = g^{ij}(x_i, p_{i1},\ldots,p_{ij},\ldots,p_{im}) = b_{ij}{}^{oi}x_i(p_{ij}/p_i)^{-oi} \tag{2}$$

$$\ln(x_{ij}) = oi \bullet \ln(b_{ij}) + \ln(x_i) - oi \bullet \ln(p_{ij}/p_i) \tag{3}$$

$$N_{iii} = -((1.0 - S_{ij}) \bullet oi + S_{ij} \bullet N_{i/i}) \tag{4}$$

For some importer, $i = 1,\ldots,n$ represents the goods or markets (for example, cotton); $j = 1,\ldots,m$ is the number of exporters (for example, the United States); x_i is the demand for the ith good from all sources; RLY is the importer's real income; x_{ij} is the ith good imported from the jth exporter (for example, cotton from the United States); p_{ij} is the real x_{ij} price in importer currency; p_i is the index of the market's p_{ij}; oi is the importer's ith market (cotton) substitution elasticity; b_{ij} is the intercept for x_{ij} demand; ln is the natural logarithm operator; N_{iii} is the importer's elasticity of x_{ij} demand with respect to p_{ij}; $N_{i/i}$ is the importer's elasticity of *market* demand with respect to p_i; and S_{ij} is the market expenditure's share spent on x_{ij}.

Armington's assumptions were designed to accomplish three things. First, two-stage importer optimization was endogenized because it is frequently observed in world trade (*2*, pp. 159, 171). Second, two-stage optimization was theoretically justified without violating Hicksian consumer theory. Armington (*2*, pp. 164–66) clearly intended to incorporate two-stage importer optimization in which product demand optima are consistent with the single-stage process of the more traditional theory of buyers' behavior. Third, "these assumptions yield a specific form for the relation between demand for a product, the size of the corresponding market and relative prices; ... the only price parameter in this function [equation 2] is the ... elasticity of substitution in that market." (*2*, p 161).

Armington's theory has four advantages. First, the often observed two-stage importer optimization procedure is endogenized in a manner consistent with the one-stage process and in a way which does not violate Hicksian consumer theory (*2*, p. 171, *9*).

Second, reduced multicollinearity may arise from the model's weak separability. Phlips (*21*, pp. 72–74) demonstrated that weak separability permits product demands to be estimated with the product's *market-related* parameters rather than with those of the entire consumption set. Nonmarket, and possibly collinear, arguments may be deleted.

Third, further multicollinearity reductions may arise through indexing of collinear prices in both stages of two-stage importer optimization. First-stage product prices are collapsed into a price index for each homogeneously separable market. The m market-related prices are collapsed into the price ratio variable in the second-stage relation (equation 2). Deleting and indexing collinear variables are multicollinearity remedies suggested by econometric texts. Yet such texts often caution the reader about the dangers of specification errors from misspecifications and omitted relevant variables (*18*, pp. 150–56, *19*, pp. 391–93). Researchers should note an important Armington model attribute: specifications that implement these multicollinearity remedies with the luxury of theoretical justification.

Armington's fourth advantage is that it permits the price elasticities to be estimated indirectly with equation 4 with nothing more than some share information, the $N_{i/i}$, and the price ration coefficient (substitution elasticity estimate).

Note that Armington's framework is a theory of demand. Armington states that his theory of "ex ante demand ... requires no particular assumptions about supply" (*2*, p. 163). I, therefore, concentrate on the demand side of the U.S. cotton export market.

Estimated Demand Model

An annual multiregional Armington model of U.S. cotton exports was estimated with OLS and SUR for 1960–81. Total U.S. cotton exports were delineated into demands by Japan, South Korea (Korea), the European Community (EC10—first 10 members), and a residual rest of the world (RESROW). Two-stage Armington behavior was not modeled for Korea. In line with previous work, one-stage Korean optimization was modeled (*3*, p. 133). Korea purchased cotton nearly exclusively from the United States throughout the estimation period (*8*). Therefore, Korean optimization was not expanded to two stages because the United States was virtually Korea's sole cotton supplier during the sample period (*3, 8*). Thus, equations 1 and 3 for non-Korean regions and Korea's Marshallian demand for U.S. cotton were estimated with OLS and SUR. Trade parameter estimates and forecast accuracy levels of the model's two versions were then compared.

Considerations on Econometric Technique

Armington's approach first determines the importer's cotton market demand, which subsequently serves as a predetermined second-stage argument (*1, 2*). For a single importer, OLS would be the appropriate econometric technique. The client region's total and U.S. cotton import demands constitute a recursive system (*19,* p. 586). Without simultaneity of the second-stage equation's market demand variable, two-stage least squares (2SLS) is not necessary. OLS estimates are consistent, unbiased, and efficient in the absence of serial correlation, contemporaneous correlation, and lagged endogenous regressors (*18*, p. 138, *19*, p. 586).

In a multi-importer framework, however, problems with contemporaneous correlation may arise; OLS estimates would be unbiased but inefficient (*18, 19*). Despite nonidentical sets of regressors, regional import demands may be contemporaneously correlated through the error, that is, "seemingly unrelated" (*19,* p. 518). Kmenta (*19*, p. 518) notes that contemporaneous correlation often confronts commodity demands across demanding agents. In light of differences in real incomes, for example, first-stage demands may be correlated through the error. Second-stage demands may be seemingly unrelated despite different logged first-stage arguments. Without serial correlation and lagged endogenous variables, SUR would be the appropriate econometric estimator for the first-stage equations as one seemingly unrelated system, and for the second-stage equations as another. SUR estimates would be unbiased, asymptotically consistent, and efficient (*18,* p. 141, *19*, p. 518). Kmenta (19, p. 525) suggests that such estimates have similar small sample properties.

Three-stage least squares (3SLS), a technique handling the combined problems of simultaneous equations and contemporaneous correlation, is not necessary for the multiregion Armington cotton model. Although contemporaneous correlation may be a problem, coefficient bias from simultaneous equations is precluded because of the recursive nature of each importer's system of first- and second-stage demands.

Comments on the Data

A few comments about the data are necessary before presenting the estimated model. U.S. cotton exports are analyzed in nonlogged terms. CIF, FOB, and GDP denote cost-in-freight, free-on-board, and gross domestic product, respectively. Real or deflated 1967 currency levels are analyzed. The U.S. dollar (dollar) serves as a proxy for RESROW currency. Price indexes and deflators have a 1967 base. Exchange rates reflect

foreign currency per dollar. The appendix details variable definitions and data sources in an effort to reconcile the Armington model's theoretically dictated variables with sources of available data.

Equation 5 shows Longmire and Morey's relationship between deflated U.S./deflated non-U.S. pecuniary terms. For importer K:

$$(PK/CPIK) = (P\$/USDEFL)*(NOMXRT(K,US)*(USDEFL/CPIK)) \quad (5)$$

where PK is the pecuniary variable in nominal kth region currency; CPIK is the kth region's consumer price index or CPI; P$ is the pecuniary variable in nominal dollars; NOMXRT(K,US) is the nominal currency K/dollar exchange rate; and USDEFL is the U.S. GNP implicit price deflator (U.S. deflator). The final two right-side terms constitute the real K/U.S. exchange rate embodying the nominal rate and the relative inflation factor (*20*).

Whenever possible, pecuniary variables for the multination EC10 are expressed in dollars, a common denominator into which pecuniary variables of the 10-member nations may be converted and aggregated. For example, real EC10 GDP is the deflated sum of national GDP's converted to dollars via the exchange rates.

For the multicountry EC10, I was unable to convert member nation exchange rates and CPI's to a common measurement unit for the sample period and consequently adopted Longmire and Morey's technique of import share-weighted indexing. Each EC10 nation's nominal exchange rate was converted to a unitless 1967 index and then weighted by that nation's share of the EC10's imported metric tonnage of wheat, corn, cotton, and soybeans. These weighted indexes were summed into a regional EC10 exchange rate index. The EC10 national CPI's were converted to a 1967 base, weighted in the same manner as the national exchange rate indexes above, and summed into an import-share-weighted regional consumer price index.

Equation Estimates

Tables 1 and 2 provide first- and second-stage econometric results with brief descriptions of the variables. The appendix collates detailed variable definitions and sources of available data.

First-Stage Estimates

Real EC10 GDP was deleted because of a negative and insignificant coefficient. Perhaps the variable's explanation of real regional income was hindered by aggregation of the real GDP's of heterogeneous nations such as small, affluent Denmark and larger, less affuent Italy. The real EC10 GDP was replaced with a "negative income" proxy, a real crude petroleum price index.

The equation for Korea represents the only market demand without a real polyester price or price proxy. A real U.S. polyester price valued in own-foreign currency was initially included in each market demand. For Japan and Korea, the real U.S. polyester price generated altogether insignificant coefficients. Perhaps Japan and Korea use non-U.S. polyester. Yet previous work (*3, 7*) suggests that real polyester price is important. Because polyester is a petroleum-based substance, the real crude petroleum price was included in the Japanese and Korean first-stage demands as a real polyester price proxy. For Korea, the proxy was also insignificant and was deleted. Results for Korea support Dyck and Siller's contention that "growth in South Korean agricultural imports ... depend heavily on growth in real income " (*8*, p. 19) (see table 1).

The lag of the real cotton world average price (cotton WAP) was included in the RESROW market demand because the lagged specification generated a more significant coefficient than the current variable. The lagged fit may be better because much of the RESROW region is in the Southern Hemisphere, which has seasons and crop cycles that are 6 months out of phase with those of the seven Northern Hemisphere exporters whose prices are incorporated into the cotton WAP. Thompson has stressed such time aggregation problems when a model spans agents in both the Northern and Southern Hemispheres. A lagged real cotton price was included in the Korean demand because it, too, fit with greater significance than current values. Perhaps the stronger lagged price's fit for Korea may have arisen from a delayed price response resulting from protectionist barriers, whereas the overall own-price variable's persisting insignificance may have arisen because Korea benefited from substantial P.L. 480 cotton shipments during much of the sample period (*8*).

Second-Stage Estimates

Several region-specific variables were included. X73 accounts for the post-1972 era of nonfixed exchange rates and high OPEC petroleum prices. X73 may also capture the impact of the entry of Britain, Ireland, and Denmark into the EC. X80 reflects the EC's admission of Greece in 1980. X7172 is intended to account for the dollar devaluations (1971–72) during the Nixon Administration and the initial stages of breakdown in the Bretton-Woods system of fixed exchange rates. X73 and X7172 were included in the relation for Japan

Table 1—First-stage demands, econometric estimates

Variable	Explanation	OLS	SUR
		Estimates	
TLCTEC:	EC10 cotton market import demand:		
INT	Intercept	4,815.590	4,925.430
t-value		12.700	13.560
RLPETPR	Negative income proxy	–137.010	–135.300
t-value		–5.740	–5.730
CTWAPEC	Real cotton WAP, EC10 currency	–3.271	–4.072
t-value		–1.600	–2.110
POLYPEC	Real polyester price, EC10 currency	1,056.760	1,078.960
t-value		6.480	6.770
R-square		.905	.903
d	Durbin-Watson	2.192	2.138
TLCTJP:	Japan cotton market import demand:		
INT	Intercept	3,615.320	3,582.920
t-value		8.730	9.130
RLGDPJP	Real GDP, Japan	.008	.009
t-value		2.140	2.340
CTWAPJP	Real cotton WAP, yen	–.017	–.017
t-value		–2.170	–2.180
RLPETPR	Real crude oil price	–82.586	–84.270
t-value		–3.400	–3.490
WTWAPJP	Real wheat WAP, yen	.015	.014
t-value		.850	.830
R-square		.488	.487
d	Durbin-Watson	1.702	1.682
USCTKO:	Korean demand, U.S. cotton:		
INT	Intercept	134.260	149.850
t-value		2.500	2.840
RLGDPKO	Real GDP, Korea	.224	.225
t-value		30.190	30.510
PUSCTKO1	Lagged real U.S. cotton price, won	.001	–.002
t-value		–1.120	–1.500
R-square		.982	.982
d	Durbin-Watson	3.333	3.219
TLCTRSRW:	RESROW cotton market import demand:		
INT	Intercept	10,492.990	10,689.300
t-value		1.870	1.930
RROWGDCT	Real GDP, RESROW	4.946	5.125
t-value		1.200	1.260
RLCTWAP1	Lagged real cotton WAP	–14.139	–13.826
t-value		–2.680	–2.630
RLPOLYP	Real polyester price	–1,575.150	–1,659.750
t-value		–.720	–.770
TREND	Time trend	–63.267	–79.755
t-value		–.180	–.230
R-square		.861	.861
d	Durbin-Watson	1.831	1.842

OLS = Ordinary least squares.
SUR = Zellner's seemingly unrelated regression.
WAP = World-average price.

Table 2—Second-stage demands, econometric estimates

Variable	Explanation	OLS	SUR
		Estimates	
USCTECLN:	Logged EC10 imports, U.S. cotton:		
INT	Intercept	–16.018	1.203
t-value		–.810	.080
TLCTECLN	Logged total EC10 cotton imports	3.098	1.199
t-value		1.490	.810
X73	Indicator variable	.751	.524
t-value		1.710	1.300
X80	Indicator variable	.908	.180
t-value		2.020	.570
TRENDLN	Logged time trend	–1.323	–1.701
t-value		–1.450	–2.230
ARMCTLN	Logged Armington price ratio	–4.748	–3.182
t-value		–2.010	–1.410
R-square		.639	.578
d	Durbin-Watson	1.972	1.499
USCTJPLN:	Logged Japanese imports, U.S. cotton:		
INT	Intercept	–10.104	–3.907
t-value		–1.530	–1.060
TLCTJPLN	Logged total Japanese cotton imports	2.438	1.615
t-value		2.880	3.500
X73	Indicator variable	.715	.599
t-value		3.000	2.940
X7172	Indicator variable	–.071	–.111
t-value		–.290	–.860
ARMCTLN	Logged Armington price ratio	–1.133	–1.327
t-value		–.960	–1.150
TRENDLN	Logged time trend	–.989	–.810
t-value		–2.720	–2.540
R-square		.499	.464
d	Durbin-Watson	1.278	1.315
t-value	t-value of lagged residual coefficient when OLS-estimated residuals regressed with OLS on own lag and equation explanatory variables	1.379	1.379
USCTRWLN:	Logged RESROW imports, U.S. cotton		
INT	Intercept	–13.847	–7.488
t-value		–2.660	–2.300
ARMCTLN	Logged Armington price ratio, cotton	–.790	–.984
t-value		–.770	–.960
TRENDLN	Logged time trend	–1.526	–1.115
t-value		–3.580	–3.320
TLCTRWLN	Logged RESROW cotton imports	2.831	2.004
t-value		4.230	4.870
X73	Indicator variable	.415	.426
t-value		2.480	2.540
R-square		.688	.660
d	Durbin-Watson	2.178	1.976

OLS = Ordinary least squares.
SUR = Zellner's seemingly unrelated regression.

to capture real exchange influences from the breakdown and disappearance of the Bretton-Woods system. Coefficients conform to expectation as the real yen/dollar exchange rate rose during 1971–72 and then dropped for a considerable time thereafter.

I modified Armington's second-stage price ratio because of low statistical significance levels and positive price coefficient estimates. That is, I replaced Armington's (*2*) price ratio specification, the U.S. price over a cotton WAP that included the U.S. price, with Sirhan and Johnson's (*23*) specification. The latter specification places U.S. price over the world average of competing non-U.S. prices. The poor initial results with Armington's ratio specification may have two explanations. First, the price ratio's denominator, the cotton WAP, may poorly reflect the world average price, so as to undermine the Armington ratio's explanation of relative U.S./world cotton export price. Second, the insignificance of the Armington price ratio coefficients may suggest weak sample evidence in support of Armington's assumptions about the substitution elasticity, estimated by the coefficient. Therefore, I used Sirhan and Johnson's price ratio specification.

Despite a Durbin-Watson statistic far into the inconclusive range, I did not correct Japan's second-stage data for first-order serial correlation. The t-value of the coefficient on the lagged residuals was insignificant when the OLS residuals were regressed against their lag and the equation's explanatory variables. Following Judge and others (*17*, p. 219), I made no corrections for serial correlation.

Trade Elasticity Estimates

Equation 4, the direct-price elasticity, was calculated for Japan, the EC10, and RESROW. Korea's own-price elasticity of demand for U.S. cotton was calculated directly from the singly modeled equation's price coefficient. Table 3 presents elasticity estimates for the OLS and SUR model versions. Worldwide elasticities are sums of regional elasticities weighted by the importer's share of U.S. cotton exports.

Table 3—Direct-price elasticities of foreign demand for U.S. cotton

Region	OLS-estimated model	SUR-estimated model	SUR difference from OLS
	Elasticities		*Percent*
EC10	4.0856	2.7475	–32.75
Japan	.9820	.9780	–.41
Korea	.0921	.1201	30.40
RESROW	.6637	.8110	22.19
World	1.1433	1.0282	–10.06

The choice of estimator affected regional estimates of direct-price elasticity more than world estimates. The elasticity estimates of the SUR and OLS model versions were nearly equal for Japan. The SUR-estimated model elasticities exceeded OLS-estimated levels for two of the three non-Japanese regions. The SUR version's elasticity of world demand for U.S. cotton was 10.06 percent less than that of the OLS version.

Theoretically, the OLS and SUR coefficient estimates are unbiased and have the same expected values (*18, 19*). SUR estimates are efficient, but OLS estimates are not (*18, 19*) (see tables 1 and 2). The *point estimates* of the inappropriately OLS-estimated coefficients and the appropriately SUR-estimated coefficients vary enough to generate noticeable differences in the policy-relevant direct-price elasticity estimates of the Armington model. Such differences range up to nearly 33 percent regionally and more than 10 percent aggregately. The proper choice of econometric technique is, therefore, an important consideration for Armington modelers who intend to estimate trade elasticities affecting U.S. policy. Two of Thompson's criticisms are clearly related: the trade parameter estimate range is too wide, and the OLS technique is often inappropriately employed. That is, ignoring the econometric problem of contemporaneous correlation and employing the inappropriate OLS estimator to the Armington cotton model have generated differences of up to nearly 33 percent in trade elasticity estimates. Such differences are partly responsible for the wide estimate range that Thompson criticized.

Forecast Errors Beyond the Sample

The mean absolute percent errors (MAPE's) were calculated for 1982–84, 3 years beyond the sample for the OLS and SUR model versions. Because of a lack of validation results from other Armington cotton models, I used the naive model's forecast statistics for comparison. The naive prediction is the previous period's actual value. Table 4 provides MAPE information. Note that the 1982–84 validation period spans a time of great market uncertainty over the parameters of the then-imminent 1985 U.S. farm bill. This situation may partly explain the rather high MAPE's of the three models, including the naive model.

World levels of U.S. cotton were most accurately predicted by the OLS-estimated model. The SUR-estimated and the naive models predicted world levels of U.S. cotton exports with nearly the same degree of accuracy. Naive regional forecasts were most accurate in three of the four cases. Regionally,

Table 4—Mean absolute percent errors (MAPE's): Foreign demand for U.S. cotton, 1982-84

Region	SUR-estimated model	OLS-estimated model	Naive model
		Percent	
EEC10	55.99	27.08	17.40
Japan	32.36	33.05	24.19
Korea	31.89	31.24	3.98
RESROW	19.52	26.02	36.38
World	19.96	14.15	19.54

the OLS and SUR versions "tied" in terms of forecast accuracy, with OLS MAPE's exceeding SUR MAPE's in two of the four cases. Furthermore, the SUR version out-performed both the OLS version and the naive model in predicting the RESROW's imports of U.S. cotton. RESROW was the single largest region, accounting for about half of U.S. cotton exports.

Again recall that SUR and OLS coefficients are unbiased with equal expected values (*18, 19*). Yet policymakers should note that OLS-SUR coefficient *point-estimates* varied sufficiently to generate noticeable differences in forecast performance. Thompson has criticized trade modelers who have failed to validate models beyond the sample and to employ the proper econometric estimator. In light of his criticisms, my findings — that the appropriately estimated SUR version fared as well as the OLS version did with regional forecasts and worse than the OLS version did with the aggregate world forecasts — are important to policymakers who may consider the Armington approach in modelling U.S. crop exports. Choice of the appropriate econometric estimator appears more critical when one is analyzing region-specific policy. These findings suggest a relationship between the Armington model's forecast performance and proper econometric technique.

The value of modeling with the OLS- and SUR-estimated structures over the naive model is apparent. First, the estimated structures provided aggregate U.S. cotton export predictions that were nearly as accurate as, or more accurate than, naive forecasts. Second, although the naive model more accurately predicted U.S. cotton exports in some regional cases, the OLS and SUR versions did provide an array of explicit and theoretically based economic relationships that one may use to analyze the impacts of specific U.S. policies on cotton. Naive forecasts fail to provide such economic intelligence.

Conclusions

This article has uncovered relationships among the four major criticisms of the agricultural trade literature. I addressed Chambers' criticism that international economic theory has been ignored or under-employed by applying the Armington model to the U.S. cotton trade. Thompson criticized the agricultural literature for failing to provide a consensus range for trade parameter estimates, for failing to test models out of sample, and for ignoring remediable econometric problems by inappropriately employing OLS. I have addressed these criticisms (1) by applying Armington theory to the U.S. cotton trade, (2) by alternatively estimating the model inappropriately with OLS and appropriately with SUR, (3) by calculating and comparing trade parameter estimates of the model's OLS and SUR versions, and (4) by testing and comparing the OLS and SUR versions' forecast performances out of sample.

Two relationships between these criticisms became apparent. First, the choice of econometric estimator for the Armington model generated a noticeable part of the trade parameter estimate range about which Thompson complained. Second, the choice of econometric estimator substantially affected the forecast performance of the Armington model beyond the sample period. That is, because readily remedied econometric problems were ignored through inappropriate OLS estimation, noticeable differences from the SUR version's parameter estimates and forecast performance were generated.

Several findings emerged from the multiregion Armington model. First, the OLS and SUR versions showed a price elasticity of world demand for U.S. cotton greater than unity. Second, the model provided a set of region-specific price elasticities of demand for U.S. cotton. No comparable trade parameter estimates from an Armington model of U.S. cotton exports have been published in a major book or journal. Third, the choice of econometric estimator influenced trade parameter point estimates across model versions. Fourth, econometric technique did influence the Armington model's out-of-sample forecast performance. The appropriately SUR-estimated structure generally predicted region-specific imports of U.S. cotton as well as the inappropriately OLS-estimated structure. The OLS version's world forecasts of U.S. cotton exports, however, were more accurate than the SUR version's counterparts.

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Appendix: Variable Definitions and Data Sources

TLCTEC, TLCTJP, TLCTRSRW = total cotton imports, EC10, Japan, RESROW, respectively; 1,000 bales of 480 lbs; Aug./July year. Sources: *(5), (11), (25)*.

TLCTECLN, TLCTJPLN, TLCTRWLN = natural logarithms (logs) of TLCTEC, TLCTJP, TLCTRSRW.

USCTKO = U.S. cotton imported by South Korea; 1,000 MT; Aug./July year. Sources: *(5), (25)*.

RLPETPR = 1967-based index of real Saudi Arabian crude light petroleum price. Constructed from nominal dollar-valued Saudi crude price and U.S. deflator. Sources: crude prices from *(13)*; U.S. deflator from *(6)*.

CTWAPEC = CTWAP*(NOMXRT(EC,US)/CPIEC) = cotton world average price (U.S. price included) in deflated EC10 currency, per 480-lb. bale, CIF Liverpool, where:

- CTWAP = weighted average of nominal dollar CIF Liverpool prices of following: U.S. Memphis territory cotton (SM 1-1/16), Brazilian Sao Paolo Type 5 cotton, Mexican cotton (SM 1-1/16), Iranian cotton (SM 1-1/16), Soviet cotton (SM 1-1/16), Turkish Izmir cotton (SM 1-1/16), Syrian Izmar cotton (SM 1-1/16). Each price is weighted by exporter's share of the exports totalled over United States, Brazil, Mexico, Iran, USSR, Turkey, Syria.
- NOMXRT(EC,US) = nominal regional EC10 exchange rate index. A regional crop import-share weighted average of 10-member nation nominal exchange rates (non-U.S. currency/dollar) converted to 1967 indexes. Each national index weighted by national share of EC10's imported metric tonnage of corn, wheat, cotton, and soybeans.
- CPIEC = regional EC10 CPI. A regional crop import-share-weighted average of 10 member nations' CPI's. National CPI's weighted as the national exchange rate indexes are in NOMXRT(EC,US).

Sources: national nominal rf exchange rates and CPI's in *(13)*; wheat trade data in *(14)*; corn and soybean trade data from *(26)*.

POLYPEC = PPLY*(NOMXRT(EC,US)/CPIEC) = polyester price in deflated EC10 currency, where:

- NOMXRT(EC,US), CPIEC = EC10's nominal exchange rate index and CPI defined above in CTWAPEC: and
- PPLY = nominal polyester price, dollars/lb.

Sources: PPLY in *(25)*

RLGDPJP, RLGDPKO = real Japanese and Korean GDP's, respectively, in own currencies. Source: *(12)*.

CTWAPJP = CTWAP*(NOMXRT(J,US)/CPIJP) = cotton world average price in deflated yen, where:

- CTWAP = nominal cotton world average price (dollars) defined above;
- NOMXRT(J,US) = nominal yen/dollar rf exchange rate;
- CPIJP = Japanese CPI.

Sources: exchange rate, CPI from *(13)*.

WTWAPJP = WTWAP*(NOMXRT(J,US)/CPIJP) = wheat world average price, CIF Rotterdam, in real yen, where:

- NOMXRT(J,US), CPIJP = Japan's nominal rf yen/dollar exchange rate and CPI;
- WTWAP = nominal dollar CIF Rotterdam world average wheat price. A weighted average of the nominal, dollar, CIF Rotterdam prices of Argentine trigo pan wheat, Canadian No. 2 Maritime North Atlantic wheat, and U.S. wheat (average wheat price). Each price weighted by nation's share of total exports of the United States, Argentina, and Canada. The U.S. average wheat price is an average of the following: (1) simple mean price of prices of U.S. No. 2 dark hard winter wheat (13.5%) and No. 2 hard winter ordinary wheat. This simple mean is weighted by the U.S. hard red winter wheat share of USWT3X; (2) U.S. No. 2 soft red winter wheat price weighted by U.S. soft red winter wheat share of USWT3X; (3) No. 2 U.S. dark northern spring wheat (14%) weighted by U.S. hard red spring wheat share of USWT3X.
- USWT3X = total U.S. exports of hard red winter, soft red winter, and hard red spring wheat.

Sources: wheat trade, wheat class, and all wheat price data in *(14)*.

PUSCTKO1 = PUSCT*(NOMXRT(K,US)/CPIKO), lagged 1 year = CIF Liverpool price of U.S. Memphis territory (SM 1-1/16) cotton in real won, where:

- NOMXRT(K,US), CPIKO are defined as Korea's nominal rf exchange rate and CPI;
- PUSCT = nominal dollar price, CIF Liverpool, U.S. Memphis territory cotton (SM 1-1/16).

Source: PUSCT in *(5)*; Korean exchange rate, CPI in *(13)*.

RROWGDCT = deflated dollar-valued RESROW GDP net of the United States, Korea, Japan, and EC10. Source: *(12)*.

RLCTWAP1 = (CTWAP/USDEFL) lagged 1 year = cotton world average price (lagged) in deflated dollars, where:

- CTWAP = above-defined nominal cotton WAP.
- USDEFL = U.S. GNP implicit price deflator (U.S. deflator). Source: USDEFL in *(6)*.

RLPOLYP = PPLY/USDEFL = polyester price/lb., deflated dollars, where:

- PPLY = nominal dollar polyester price/lb. defined above in POLYPEC,
- USDEFL = U.S. deflator.

ARMCTLN = natural log of (PUSCT/CTWAPNUS) = logged Armington price ratio for cotton. The ratio of PUSCT defined above in PUSCTKO1 over CTWAPNUS, where:

- CTWAPNUS = nominal dollar-valued, CIF Liverpool world average price defined in CTWAPEC, but exclusive of U.S. price.

ARMCTLN1 = ARMCTLN above lagged one period.

X73 = indicator variable: 1.0 for post-1972; 0 for pre-1973.

X80 = indicator variable: 1.0 for post-1979; 0 for pre-1980.

X7172 = indicator variable: 1.0 for 1971–1972; 0 otherwise.

TREND = time trend: 1960 = 11.0 1981 = 32.0.

TRENDLN = natural logarithm of TREND above.

USCTJPLN,USCTECLN, USCTRWLN = natural logs of U.S. cotton exports of Japan, EC10, and RESROW, respectively. 1,000 MT values, Aug./July year. Sources: *(5), (25)*.

Pathologies of the Market and Their Cure

Government is a kind of social agriculture, distorting the market system in the direction of higher human valuations without destroying it and always accommodating to its principles. The "invisible hand" is a necessary partner of the visible hand of conscious intervention. Without understanding their properties and limitations, both the visible and the invisible hands easily turn into fists which are destructive. This does not mean to say, however, that we should never turn woods into farms or never have a government to produce favorable distortions in the market.

Kenneth E. Boulding
Market Process, Vol. 4, No. 1, Spring 1986

Book Reviews

Expanding the Risk Analysis Toolkit

The Competitive Firm's Response to Risk. *By Lindon J. Robison and Peter J. Barry. New York: Macmillan Publishing Company, 1987, 324 pp., $37.50.*

Reviewed by Beverly Fleisher

"Risk is like love; we have a good idea of what it is, but we can't define it precisely." This statement, made by Stiglitz several years ago, describes the position of risk in decision theory today. Economists acknowledge the importance of risk in both individual decisionmaking and policy formation. However, like other students of decisionmaking, economists are often stymied by the absence of concrete answers to basic questions, including a rigorous definition of "risk."

Although rigor itself would dictate against building a superstructure of risk analysis on shaky foundations, the immediate need for economists to address risk-related questions suggests that an evolutionary approach to the development of tools must be taken. Robison and Barry respond to the need of economists for tractable tools by developing expected value-variance models as a means of conducting comparative static analysis of the competitive firm's response to risk.

Robison and Barry carefully delimit the area of their work. They point out that microeconomic theory under risk or uncertainty is only one area within the realm of decision theory. And, expected value-variance is only one of several analytic tools that analysts can use to extend microeconomic theory into the world of risk.

This narrowing of focus from decision theory as a whole to one method of analyzing specific types of risk-related problems in economics is, in fact, what makes the book useful. The lack of a consensus on risk theory and methods and the fact that risk influences nearly every economic situation or decision makes it impossible for any one book to cover the field in both breadth and depth. Three approaches have been used, each with its own strengths and weaknesses, One approach is an overview of risk and its effects on a given environment. *Risk Management in Agriculture,* edited by Peter Barry, is an example of this genre. The second approach is a summary, comparison, or review of models and methods. John Hey's *Uncertainty in Microeconomics* represents this approach. The third approach, taken by Robison and Barry, is the development of single method and its application to a variety or situations.

The book's early chapters set the stage by reviewing many risk-related concepts and issues and defining terms. This process is more than a nicety; it is a necessity in an interdisciplinary field where even individuals in one discipline do not agree on the meaning of basic terms. Although all readers will glean something from the review, individuals unfamiliar with risk analysis may need to supplement this material.

Examination of the competitive firms' response to risk begins in earnest in the second part of book. Robison and Barry present the expected value-variance framework and provide careful mathematical and intuitive expositions of income and substitution effects under risk.

Robison and Barry consider a wide variety of possible responses to risk by the firm. Each chapter addresses either one risk management tool, such as hedging, or a set of parameters, such as the firm's financial structure, that can be altered to manage risk.

The authors first consider situations in which the distributions of outcomes available to the firm are positive linear transformations of the random variable. This property of the distribution leads to a ranking of outcomes that are guaranteed to be consistent with those obtained by expected utility models. Among the decision situations meeting this criterion are the choice of optimal output under price uncertainty, optimal input use under risk, and the use of risk-reducing inputs, hedging, diversification, share leasing, and information as risk responses.

The reviewer is an agricultural economist with the Resources and Technology Division, ERS.

Perhaps more interesting are the cases where there is no obvious, direct linkage between the random variable and the outcome of concern. In these cases the consistency between expected value-variance and the results of expected utility models can no longer be guaranteed. Robison and Barry argue that, when properly framed in terms of indirect and direct outcome variables, many *ad hoc* decision rules will lead to rankings of choices consistent with expected utility models. It is unfortunate that the chapter detailing this argument may leave readers with questions. But, the concepts become clearer as Robison and Barry lead the reader through subsequent analyses of insurance, management of financial structure, flexible durables, participation in public programs, and new technology as responses to risk.

Although most of these situations have been modeled many times, Robison and Barry are not content just to report earlier findings. In addition to discussing pertinent literature, they extend previous work by relaxing assumptions and specifying and testing new hypotheses.

The book draws together much of the literature on firms' response to risk that is scattered throughout journals and other technical outlets. Because the literature is presented within a consistent framework, *The Competitive Firm's Response to Risk* is an important addition to the reference library of any economist concerned with microeconomic analysis. However, users must keep in mind that the book presents just one of the many models, methods, and theories that comprise decision science.

The book expands the limited number and types of texts available for teaching economists about risk decisionmaking. Almost any course related to risk and decisionmaking would benefit from the statistical appendix, which provides the background necessary to understand the stochastic specifications of risk-related models. The curriculum for those receiving their first introduction to the economics of risk should also include the foundation-building chapters supplemented by additional, less cursory material to provide the framework for analysis. Graduate students and professionals for whom risk is not a primary focus would also benefit from the presentation of expected value-variance as an analytic method as well as the specific models that are pertinent to their interests.

Although this book is not for the mathematically fainthearted, the reader need not be mathematically sophisticated; 1 year of calculus, the statistical review provided in the appendix, and a willingness to spend some time working through areas of specific interest are all that are required. Both students and professionals will be rewarded with an analytic tool that, though imperfect, is a foundation for thinking about the many risk-related questions economists face in the course of their work.

In Earlier Issues

Our analysis shows that the researcher involved in policy research must carefully evaluate the relationships among the price elasticities in the model. The researcher can use sensitivity analysis to evaluate the effect of differing sets of elasticities on the magnitude and direction of impacts, particularly when the researcher doubts the quality of the empirical estimates.

Philip L. Paarlberg and Robert L. Thompson
Vol. 32, No. 4, October 1980

Tools of the Trade

Elements of Agricultural Trade Policies. *By James P. Houck. New York: Macmillan Publishing Company, 1986, 191 pp., $29.95.*

Reviewed by John Wainio

One of the most basic and important contributions of the field of economics is the concept that countries can mutually benefit from free trade. If country A raises corn and country B cattle, both may increase their total economic welfare by exchanging corn for cattle. Through the price and exchange rate systems, the process can be extended to accommodate an infinite variety of goods and services.

Despite strong theoretical arguments in favor of free trade, economists have difficulty convincing policymakers of the net social costs associated with policies to restrict trade. Evidence of the problem is widespread, as government policies around the world that constrain and distort trade, particularly in agricultural commodities, have proliferated.

Houck reminds the reader very early that the benefits of free trade are usually spread widely and thinly among numerous individual consumers, whereas the costs and hardships are nearly always borne by relatively few. Grasping this fundamental disparity in the incidence of benefits and costs is essential in understanding why the economic arguments for free trade laid out in this book are often ignored by elected officials. As Houck points out, a 2-cent-per-pound increase in the price of sugar caused by an import quota will prompt few consumer protests. Yet an equivalent fall in sugar prices for growers because of increased imports will surely cause sugar producers and their representatives to press strongly and persuasively for protection. It is this search for protection that lies behind much of the book's analysis.

The first part of the book lays the groundwork, explaining some of the economic concepts used in trade theory such as comparative and absolute advantage, specialization, and gains from trade. It discusses familiar arguments offered for protection against international competition, emphasizing those commonly used by the agricultural sector. The essential nature of food and fiber to human welfare, the biological character of agricultural production, and the long-term behavior of prices and incomes have made agriculture a prime candidate for government intervention and, thus, a useful focal point for a book on trade policies. The first section concludes with an introduction to partial equilibrium analysis, the major analytical tool employed throughout the book.

The second part deals with the traditional mechanisms by which governments of importing nations intervene to shield their domestic producers from foreign competition. These mechanisms include tariffs, quotas, variable import levies, and deficiency payments. This section also analyzes trade intervention on the import side aimed at benefiting the consumer or user of foreign products via import and consumption subsidies. The general approach is to first graph the partial equilibrium framework for the trade policy in question. Next, the direct effects on domestic and international prices, production, consumption, trade, and government revenues are analyzed. Small- and large-country cases are compared. Finally, the domestic and foreign gainers and losers are identified, which requires the reader to have some understanding of the concepts of producer and consumer surplus. However, the reader needs only a rudimentary knowledge of economic theory and mathematics to understand the analysis.

The third part deals with the trade policy of exporters. It covers the economics of export and production subsidies, food aid, and trade expansion. Nonexpansionary trade policies, including export taxes, controls, and embargoes are also discussed. The focus is again on assessing the direct and immediate impacts of a particular policy. Although this approach suppresses interactions between commodities and ignores the dynamic time paths of adjustment, it is useful in highlighting the differences among policy options targeted at specific commodity problems.

The reviewer is an economist with the Agriculture and Trade Analysis Division, ERS.

The final part covers additional topics in trade policy economics. The simple, straightforward analysis is extended to such issues as the protection of interlocked raw material and final good sectors in an international trading environment, trade preferences and economic integration, the effects of movements in the exchange rate on trade policies, and the destabilizing effects of trade policies on the international market.

The book is not an exhaustive treatise on the economics of agricultural trade policies, nor is it meant to be. Its value lies in being a clear and consistent introduction to the subject for the student and a useful reference for the researcher. The user will particularly appreciate the annotated list of additional readings at the end of each chapter.

Even readers without previous exposure to partial equilibrium analysis should quickly become adept at using this approach to uncover the broad effects of trade policies. In keeping the analysis simple, however, Houck has omitted any reference to specific agricultural trade issues and problems of the day. This is a regretable concession to the complexity of today's agricultural trade issues, which require an analysis beyond the simplistic approach used in the book. Nonetheless, the book is not without insights into what is happening in the area of international trade and trade policy. Some examples:

- Protection from the painful economic adjustment brought on by inevitable changes over time in international patterns of comparative advantage is the most common cause underlying government intervention in trade.

- An ingenious variety of nontariff barriers has replaced tariffs in many agricultural product markets. Their distorting effects on trade and price are subtle, but potentially quite effective. Because nontariff barriers often originate deep within goverment bureaucracies and may not reflect deliberate policy goals, they are troublesome to negotiate.

- As a protective device, the variable import levy is among the most effective, hence notorious, in the international arena. Importing nations typically view their variable levy schemes as nonnegotiable, since to do so would allow decisions about the level and process of a government's price guarentee to domestic producers to be influenced by external factors.

- In contrast, the protective transfer from a deficiency payments scheme is not "hidden" in higher consumer prices, but appears clearly in the national budget and in the records of the operating agency. It is, therefore, subject to direct scrutiny by taxpayers and consequently forces domestic producers to constantly restate and defend their favored status.

- The public effect of an individual nation's trade policy on other countries is perhaps most obvious when export subsidies are used. Such subsidies involve overt, positive actions that tend to depress international prices and narrow market outlets for other producers. Like deficiency payments, they are a clear, obvious transfer item in the national budget and are, therefore, open to scrutiny by all.

- Although both the farm and rural populations have dwindled, few countries have dismantled their systems of market intervention. This situation underscores one of the overlooked costs of instituting a protectionist policy in any given year, namely, the difficulty of reducing or eliminating intervention once it is in place.

In Earlier Issues

The very nature of economics places an extra ethical burden on economists to use writing even more effectively than other scientists. Economics deals with the most efficient use of resources, and writing is one of the leading resources of the economist.

Ronald L. Mighell and Elizabeth Lane
Vol. 25, No. 1, January 1973

Better Irrigation Through Systems Management

Irrigation Investment, Technology, and Management Strategies for Development. *By K. William Easter (ed.). Boulder, CO: Westview Press, 1986, 207 pp. $27.50.*

Reviewed by John C. Day

Development specialists believe that irrigation schemes in Third World countries have generally not lived up to expectations. Many systems have failed to generate the levels and distribution of farm output and income that were originally anticipated. As editor, Easter takes this gap between expectations and reality as his "problem statement." His introductory remarks indicate that the issue is how to improve the performance of existing and future irrigation projects so that they will realize their potential and contribute more to agricultural growth in developing countries. The collected papers focus on the need for better project evaluation, planning, and operation and maintenance rather than on matters relating to technical design and construction.

The 14 chapters by different authors rely for source material on research sponsored by the U.S. Agency for International Development and papers selected from presentations at a workshop on water management held in Thailand, 1983. All the material is written in terms that should be understandable to both the irrigation specialist and the general reader.

The thematic organization of the book is largely along country lines, although there is an introductory section of three chapters that defines the overall purpose, scope, and issues to be covered. Three chapters deal with irrigation problems and potentials in India and focus on strategies for improving small-scale irrigation schemes through better management and rehabilitation efforts. Criteria for selection of tank systems to be rehabilitated are developed in this section. The next three chapters review irrigation issues in Thailand, again emphasizing small-scale tank and river pumping schemes. A special feature is an assessment of an Asian Development Bank approach utilizing small pilot projects to identify management practices that will improve the performance of a large irrigation project. Of particular interest is a chapter presenting a critique of agricultural policies as determinants of schemes successful in Thailand. One chapter summarizes the impact of water trading and water markets on system operations in tube-well projects in Pakistan, and another shows the effect of alternative water pricing mechanisms on a representative farm in Egypt's northern delta. Another chapter discusses case studies of the implications of community ownership on the operation of small-scale irrigation systems in Asia. The final summary chapter offers recommendations for future activity including research needs.

My reaction to the book is somewhat mixed. It contains considerable information on irrigation system operations in major regions of the world. The geographic coverage is not intended to be exhaustive, but selective. It emphasizes small-scale systems as opposed to large-scale systems such as the Gezira and the Rahad schemes in the Sudan. Easter includes pieces that explain the important role farmers play in efficient system operation and water allocation. This contribution is often overlooked in project planning and operation efforts. The interpretive sections written by Easter and some of his colleagues on the AID project provide the necessary insight and syntheses needed for drawing conclusions from the cross-country studies. These aspects of the book provide practical guidance to irrigation planners.

Perhaps too much attention is given to factors that affect the technical management of the physical aspects of irrigation (including water allocation), and not enough to the influence of general agricultural policies and programs on farmers and their decisions about crop and livestock production. It is, after all, these decisions affecting the whole complex set of farm input-output relationships that ultimately determine the success of an irrigation scheme. Although two chapters deal with the importance of water markets and pricing on system operations and farm water use and income, only one chapter is

The reviewer is an agricultural economist with the Resources and Technology Division, ERS.

devoted to general policy effects. In fact, in this chapter author Sam Johnson says: "irrigation infrastructure is a necessary, but not sufficient, condition for expanded agricultural production. Other agricultural policies must complement the irrigation investment in order to obtain positive production increases" (p. 112). Thus, in terms of the marginal gains to new knowledge, I wonder if the payoff to more concentrated attention on economic policies affecting such things as input/output prices, exchange rates, inflation, exports, food aid importation, regional growth objectives, input subsidy programs, food vs. export crop incentives, and their impacts on irrigated farming and system effectiveness might not have been great. In the concluding list of policy recommendations, for example, only one of eight is directed at government agricultural policies.

One last comment concerns the "flow" of narrative from chapter to chapter as it relates to identification of problems, issues, and solutions. The country-by-country approach is perhaps too repetitious. Given this organization, repetition is unavoidable because many of the same problems and issues arise wherever irrigation development is undertaken. However, Easter's introductory and summary chapters sort out the lessons to be learned from a variety of situations.

This book is a useful addition to the literature on water resources development because it helps readers understand the complex set of technical, institutional, and economic factors that work together to determine the success or failure of irrigation schemes everywhere.

In Earlier Issues

Agricultural economics work is carried on in the public interest and every researcher or statistician, regardless of his field, does have a responsibility for seeing that his material is prepared in such a way as to be readily accessible to his fellow workers and to the public.

O.V. Wells
Vol. 1., No. 1, Jan 1949

An Equation for Starvation

Markets and Famines. *By Martin Ravallion. Oxford, England: Clarendon Press, 1987, 203 pp., 22 10s.*

Reviewed by Carl C. Mabbs-Zeno

Ravallion takes sides early in this book on the debate over whether to focus on food availability or on food distribution in analyzing famine. For him, the entitlement approach, as expressed in the language of A.K. Sen, with its attention to distribution of inputs and products, is the more useful, although this volume avoids some of the more controversial theoretical distinctions associated with this approach. Landlessness is mentioned, but most parameters are modeled with little attention to potential for political or class analysis. The role of markets in causing famine depends, in this analysis, on the allocation of food consumption among individuals who differ essentially in initial resource endowment.

The title, *Markets and Famines,* overstates the coverage of this volume because nearly all its analysis relies on data from Bangladesh and British India. Since markets are probably more important in allocating food in the Indian subcontinent than in any other area that has suffered famine since World War II, this is a productive site for observing market effects, but a poor model for famine-prone economies in general. There is much to recommend, however, in relation to the more modest goal of measuring market effects that contributed to the 1974 famine in Bangladesh.

Ravallion uses several econometric investigations to test hypotheses about how markets affect an area's vulnerability to famine. The most interesting hypothesis relates increased price instability to increased mortality. Two case studies showed that price instability accounted for about a third of mortality due to famine. Another innovative test related expectations about future food availablility, as revealed in current newspaper reports, to current food prices. It found that expectations were important and that they underestimated food production in 1974, thereby retaining prices and reducing consumption beneath the optimal level.

Ravallion avoids speaking about "optimal policy" even though the objective function in his normative equations is among the least controversial economic objectives, namely, to minimize famine mortality. His formal style, which rejects such loose terminology, is unusual in the field of famine research where data are generally poor and emotions generally run high. Ravallion pays considerable attention to the theoretical manipulation of propositions that are widely accepted by academics and policymakers working on famine; for example, greater inequality in food consumption raises famine mortality. His style results in an admirably rigorous presentation of other, nontrivial points, that are accessible, however, only to academics.

The coverage of government policy options for coping with famine is incomplete both with respect to the range of policies considered and the range of possible policy effects. Significant contributions to famine theory are offered for policies of price control and food stocking. The discussion on expectations about future harvest offers some important insights, but Ravallion's suggestion of periodically surveying private traders seems a disingenuous empirical foundation for policy. The narrow focus of the book may limit its interest for general readers, but not for specialists on famine, market failure, or Bangladesh.

The reviewer is an agricultural economist with the Agriculture and Trade Analysis Division, ERS.

Lament on Bad Writing

Oh woe to the reader of ponderous journals
who works to extract all the well-hidden kernels
of truths so unbold, conclusions too trite,
of messages simple, results without light.
Hidden they must be, beneath all the jargon,
for knowledge like this we are sure is no bargain.

True bargains are scarce and, if to be found,
the reader must slog o'er the mountainous mound
of bad lit, to be able to know what he's found.

This is it! he will cry.
Ah, but how would he know
such a gem, he will sigh
if the mountain of bad lit had not been so high?

Along comes McCloskey, to throw out a line
to writers who write as if all have no minds:
Avoid wordy and boring, use one word for two;
Be active! Not passive. The simple will do.
The readers will shun you if you cannot be brief.
The writing you peddle is giving them grief!
So clean up your act, with yourself make a pact,
to useless bad lit you will never go back.

Barbara Stucker

Stucker is an economist (not a poet) with the Agriculture and Trade Analysis Division, ERS. The poem was prompted by a review of Donald McCloskey's *The Writing of Economics* in the Spring 1987 issues of the Journal.

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